

## CLAIMS

What is claimed is:

- 1 1. A system for identifying pixels inside a graphics primitive of a raster image  
2 comprising:  
3 a memory for storing a raster image; and  
4 a graphics engine coupled to the memory and including a pipeline structure, the  
5 pipeline structure receiving information related to polygonal portions of the raster  
6 image from the memory and information related to graphics primitives from a source  
7 for determining whether a polygonal portion of the raster image is at least partly inside  
8 the graphics primitive.
- 1 2. The system of claim 1 wherein the pipeline structure further comprises a  
2 predetermined number of sequential logic circuits and a predetermined number of  
3 parallel logic circuits.
- 1 3. The system of claim 1 wherein the pipeline structure divides the polygonal  
2 portion into a predetermined number of polygonal subportions if the polygonal portion  
3 is at least partly inside the graphics primitive.
- 1 4. The system of claim 1 wherein the pipeline structure determines whether the  
2 polygonal portion of the raster image is at least partly inside the graphics primitive by  
3 evaluation of edge functions of the graphic primitive.

1 5. The system of claim 4 wherein each edge function of the graphics primitive is  
2 based on a general edge function,  $e(x, y) = e_0 + n_x x + n_y y$  where  $e_0$  is a constant,  $n_x$  is the  
3 x-component of a normal vector  $\underline{n}$  which is normal to an edge of the primitive and  $n_y$  is  
4 the y-component of the normal vector  $\underline{n}$ .

1 6. The system of claim 4 wherein the edge function is evaluated at a corner vertex  
2 of the polygonal portion, the corner vertex being farthest in a positive direction from a  
3 primitive edge associated with the edge function.

1 7. The system of claim 2 wherein the pipeline structure is configured such that the  
2 sequential logic circuits are coupled together in series followed by the parallel logic  
3 circuits coupled together in parallel.

1 8. The system of claim 2 wherein the pipeline structure comprises seven sequential  
2 logic circuits connect in series and seven parallel logic circuits coupled together in a  
3 multi-stage pyramid structure.

1 9. The system of claim 3 wherein the pipeline structure determines the two  
2 polygonal subportions by determining midpoint values of two opposite sides of the  
3 polygonal portion of the raster image and using the midpoint values as vertices of the  
4 two polygonal subportions.

1 10. The system of claim 1 wherein the pipeline structure further comprises a  
2 predetermined number of pixel engines for determining attribute values associated  
3 with each pixel.

1 11. The system of claim 1 wherein the polygonal portion of a raster image has a  
2 width  $\Delta X$  and a height  $\Delta Y$ , each of the width  $\Delta X$  and the height  $\Delta Y$  having a value of  
3  $2^m$ .

1 12. A method of identifying pixels inside a graphics primitive of a raster image,  
2 comprising the steps of:

3 (a) determining whether a polygonal portion of the raster image is at least partly  
4 inside the graphics primitive;

5 (b) dividing the polygonal portion of the raster image into a predetermined  
6 number of polygonal subportions if the polygonal portion of the raster image is at least  
7 partly inside the graphics primitive;

8 (c) determining whether each polygonal subportion of the raster image is at least  
9 partly inside the graphics primitive; and

10 (d) further dividing the polygonal subportion into a predetermined number of  
11 polygonal subportions if the polygonal subportion is at least partly inside the graphics  
12 primitive and is larger than a pixel.

1 13. The method of claim 12 further comprising the step of recursively performing (c)  
2 and (d) until there are no more polygonal subportions that are at least partly inside the  
3 graphics primitive.

1 14. The method of claim 12, wherein the determining step (a) further comprises the  
2 step of receiving a plurality of values for corner vertices of the polygonal portion and  
3 arithmetic edge functions related to the graphic primitive having a coordinate reference  
4 frame located at a geometric center of the polygonal portion, the arithmetic edge  
5 function corresponding to an edge of the graphics primitive.

1 15. The method of claim 14, wherein the determining step (a) further comprises the  
2 step of evaluating an arithmetic edge function received at a corner vertex of the  
3 polygonal portion, the corner vertex being farthest in a positive direction relative to the  
4 corresponding edge of the graphics primitive.

1 16. The method of claim 15 wherein the polygonal portion is at least partly inside the  
2 graphics primitive if all arithmetic edge functions evaluated are positive.

1 17. The method of claim 12 wherein the dividing step (b) further comprises the step  
2 dividing the polygonal portion into two polygonal subportions by determining  
3 midpoint values of two opposite sides of the polygonal portion.

1 18. The method of claim 12 wherein the dividing step (b) further comprises the step  
2 of sequentially deriving two new sets of arithmetic edge functions associated with a  
3 translated coordinate reference frame located at a geometric center of a corresponding  
4 one of the polygonal subportions.

1 19. The method of claim 12 wherein the dividing step (b) further comprises the step  
2 of sequentially outputting multiple sets of information, wherein each set of information  
3 includes corner vertices of one of the created polygonal subportions and a  
4 corresponding new set of derived arithmetic edge functions.

1 20. An electronically-readable medium having embodied thereon a program, the  
2 program being executable by a machine to perform method steps for identifying pixels  
3 inside graphics primitives of a raster image, the method steps comprising:

4 (a) determining whether a polygonal portion of the raster image is at least partly  
5 inside the graphics primitive;

6 (b) dividing the polygonal portion into a predetermined number of polygonal  
7 subportions if the polygonal portion is at least partly inside the graphics primitive;

8 (c) determining whether the polygonal subportion is at least partly inside the  
9 graphics primitive for each polygonal subportion; and

10 (d) dividing the polygonal subportion into a predetermined number of  
11 polygonal subportions if the polygonal subportion is at least partly inside the graphics  
12 primitive and the polygonal subportion is larger than a pixel.

1 21. The electronically-readable medium of claim 20 further comprising the step of  
2 recursively performing steps (c) and (d) for each polygonal subportion larger than a  
3 pixel that is at least partly inside the graphics primitive.

1 22. A method of identifying pixels inside a graphics primitive of a raster image  
2 comprising the steps of:

3 selecting a tile including a pixel;

4 determining if a portion of the tile is within the graphics primitive;

5 dividing the tile into subtiles if a portion of the tile is within the graphics  
6 primitive; and

7 recursively dividing each subtile having a portion within the graphics primitive  
8 until the subtile is equal in size to a pixel.

1 23. The method of claim 22 further comprising the step of disregarding the tile or  
2 subtile from subsequent decomposition if the tile or subtile is outside of the graphics  
3 primitive.

1 24. The method of claim 22 wherein the step of determining further comprises  
2 evaluating the tile at a corner vertex which is farthest in a positive direction relative to a  
3 current edge of the graphics primitive.

1 25. The method of claim 22 wherein the step of recursively dividing further  
2 comprises determining if the subtile is at least partly within the graphics primitive by  
3 evaluating the subtile at a corner vertex which is farthest in a positive direction relative  
4 to a current edge of the graphics primitive.

1 26. An electronically-readable medium having embodied thereon a program, the  
2 program being executable by a machine to perform method steps for identifying pixels  
3 inside graphics primitives of a raster image, the method steps comprising:  
4 selecting a tile including pixels;  
5 determining if a portion of the tile is within the graphics primitive;  
6 dividing the tile into subtiles if a portion of the tile is within the graphics  
7 primitive; and  
8 recursively dividing each subtile having a portion within the graphics primitive  
9 until the subtile is equal in size to a pixel.